DTC ENSEMBLE TESTBED (DET)

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OUTLINE / SUMMARY

- Why do we need probabilistic / ensemble forecasts?
  - Everyday and professional decision making
- Pressing need for ensemble testbed
  - Agencies, community ready
- DET functions
  - Develop / maintain infrastructure
  - Test & evaluation
- Link with other testbeds / programs
  - HMT, HWT, HFIP, Hydro, NEXTGEN, NUOPC, etc

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WHY DO WE NEED ENSEMBLE FORECASTS?

- Atmosphere is nonlinear system
  - Error evolution can be highly non-linear
  - Probabilistic forecast based on single integration can have serious limitations

- Real life user situations can be complicated & highly nonlinear
  - Users have myriad factors to consider beside weather
  - Decision making via study of hypothetical scenarios is imperative
    - Utility company designs optimal strategy before hurricane hits
      - Must have model of operations, incorporating effect of weather
    - "Downstream" applications
      - E.g., Flood forecasting via hydrologic ensemble forced by atmospheric ensemble

- Users often affected by numerous weather variables
  - Need to know co-variance across time, space, variables
    - E.g., probability of wind above X, temp below T, and precip above P
  - Traditional statistical methods cannot practically deliver such info

FORMATION OF DET IN FY2010

Confluence of necessary ingredients

- Need
  - Strong interest from both community & agencies
- Knowledge base
  - Roadmap from Sept 2009 Workshop
    - National Workshop on Mesoscale Probabilistic Prediction at NCAR
- Opportunity
  - Increase in funding for DTC from NOAA
- Initiative
  - DTC Director's Office sets planning process in motion (Oct 09)

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DET MAJOR TASKS

- Develop and maintain DET infrastructure
  - Modularity to allow community testing
  - NCEP operational system as benchmark
- Test and evaluate new community methods
- Link up with ensemble work in other testbeds

Input from revived WRF Ensemble WG

Start with meso-scale ensemble work

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DET INFRASTRUCTURE COMPONENTS

- Ensemble configuration — 2010
  - Ability to run multiple integrations
- Initial perturbations — 2010
  - Represent effect of uncertainty in analysis
- Model perturbations — 2011
  - Represent model related uncertainty
- Statistical post-processing — 2011
  - Correct systematic errors / improve skill
- Probabilistic products — 2011
  - Ensemble displays / user relevant products
- Ensemble / probabilistic verification — 2011
  - Link with MET

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RESEARCH / DEVELOPMENT QUESTIONS

- Ensemble configuration
  - Trade-off between resolution and membership
- Initial perturbations
  - What is best method to represent analysis uncertainty?
    - SVs, Ensemble Transform, EnKF, etc?
- Model perturbations
  - Test different stochastic parameterization schemes
- Statistical post-processing
  - What methods to use, how to create representative forecast sample?
- Probabilistic products
  - Build superset of tools from NAWIPS, AWIPS2, etc packages
- Ensemble / probabilistic verification
  - Complement MET with additional ensemble/probabilistic metrics

DET TESTING / EVALUTION & LINKS

- DET testing / evaluation plan 2010
- Plans for link with HMT ensemble 2010
- DET test / evaluation begins 2011
- Plan for links with HWT & HFIP 2011
- Links with other programs 2012
  - Hydro ensemble, NEXTGEN, NUOPC, etc

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DET CHALLENGES

- Hire / train new personnel
  - DET task lead, SE, etc
- Identify computer resources for testing / evaluation
  - NCAR, GSD, and external resources
- Establish ensemble code depository, community support
- Define test / evaluation protocol for DET
- Link up with wide ranging national and possibly international ensemble research / development work
  - Make widely usable software part of DET depository?

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BACKGROUND

DTC ENSEMBLE TESTBED (DET)

- Objectives
  - Provide access to operational codes to community
  - Test and evaluate new methods developed by community
  - Support other testbeds / programs with their ensemble work
- Initial focus
  - National meso-scale ensemble system
- Organization
  - NCAR & GSD participation, with EMC/NCEP collaboration
- Status
  - Planning and development of basic capability began
    - Review by WRF Ensemble Working Group at Aug DET Workshop

FUTURE DET TESTING (2011 & BEYOND)

- Areas of interest
  - Ensemble configuration, initial condition & model related perturbations, statistical post-processing, probabilistic products & verification

- List of candidate methods for representing initial condition related uncertainty
  - Singular vectors (SV)
    - Fastest growing errors – potentially worst scenario
  - Breeding / Ensemble Transform (ET)
    - Likely errors
  - ETKF, EnKF, other ensemble-based DA methods
    - Attempts to more directly link ensemble & DA systems

DET TEST & EVALUATION PLAN

- Rules of engagement
  - Definition of modules with clearly defined interfaces
  - Software engineering requirements (NEMS, etc)

- Testing protocol
  - Effect of changed module on performance of end-to-end system
  - Operational system as benchmark
  - Set of predefined metrics
    - Quality, computational performance

- Recommendation for further testing at NCEP
  - Best performing changes passed on to NCEP
    - NCEP considers transition to operations